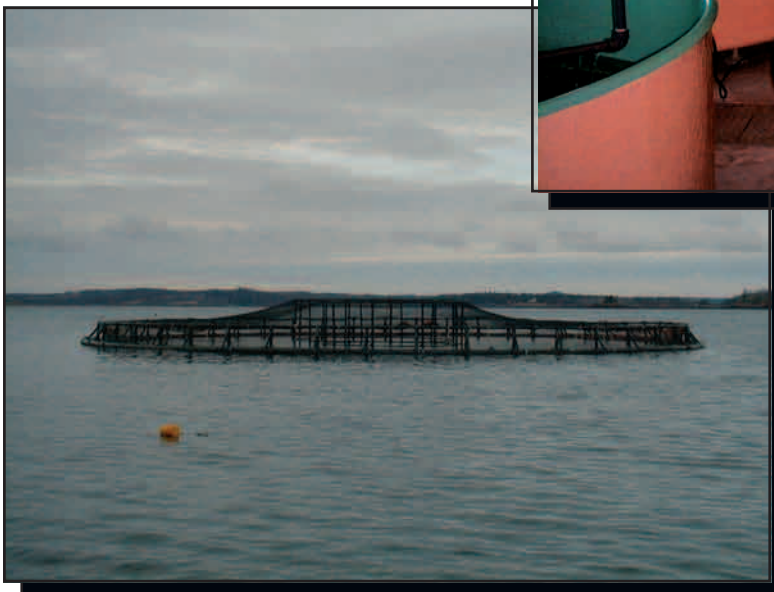




Economic and Environmental Benefits Analysis of the Final Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Industry Point Source Category



United States Office of Water (4303T)
EPA-821-R-04-013
Environmental Protection Agency
Washington, DC 20460

June 2004

Economic and Environmental Benefits Analysis of the Final Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Industry Point Source Category

Stephen L. Johnson
Acting Deputy Administrator

Benjamin H. Grumbles
Acting Assistant Administrator, Office of Water

Mary T. Smith
Director, Engineering and Analysis Division

Christopher J. Miller
Lisa McGuire
Renee Selinsky Johnson
Project Analysts

Engineering and Analysis Division
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, D.C. 20460

June 2004

ACKNOWLEDGMENTS AND DISCLAIMER

The Office of Science and Technology prepared this document with the support of Eastern Research Group, Incorporated and Tetra Tech, Incorporated.

Neither the United States government nor any of its employees, contractors, subcontractors, or other employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use of, or the results of such use of, any information, apparatus, product, or process discussed in this report, or represents that its use by such a third party would not infringe on privately owned rights.

CONTENTS

| | <u>Page</u> |
|--|----------------|
| EXECUTIVE SUMMARY | ES-1 |
| ES.1 INTRODUCTION | ES-1 |
| ES.2 DATA AND METHODOLOGY | ES-2 |
| ES.2.1 Data Sources | ES-2 |
| ES.2.2 Regulated Community | ES-3 |
| ES.2.3 Cost Methodology | ES-3 |
| ES.2.4 Economic Impact Methodology | ES-4 |
| ES.3 EPA’S ESTIMATE OF REGULATORY COSTS | ES-7 |
| ES.3.1 Costs to Regulated Facilities | ES-7 |
| ES.3.2 Costs to the Permitting Authority (States and Federal Governments) ... | ES-8 |
| ES.4 EPA’S ESTIMATE OF REGULATORY IMPACTS | ES-8 |
| ES.4.1 Financial Effects to Regulated Operations | ES-8 |
| ES.4.2 Economic Effects to National Markets | ES-11 |
| ES.5 COST-BENEFIT ANALYSIS | ES-12 |
| ES.6 REFERENCES | ES-14 |
| CHAPTER 1 INTRODUCTION | 1-1 |
| 1.1 SCOPE AND PURPOSE | 1-1 |
| 1.2 DATA SOURCES FOR THE FINAL RULE | 1-2 |
| 1.3 OVERVIEW OF CHANGES TO ECONOMIC METHODOLOGY | 1-3 |
| 1.4 REPORT ORGANIZATION | 1-4 |
| 1.5 REFERENCES | 1-4 |
| CHAPTER 2 EPA DETAILED QUESTIONNAIRE SURVEY | 2-1 |
| 2.1 FACILITY COUNTS | 2-1 |
| 2.2 COMMERCIAL FACILITIES | 2-4 |
| 2.2.1 Enterprise Information | 2-4 |
| 2.2.2 Facility Information | 2-5 |
| 2.2.2.1 Geographic Distribution | 2-5 |

| | | |
|--|---|------------|
| | 2.2.2.2 Revenues | 2-5 |
| | 2.2.2.3 Production | 2-6 |
| | 2.2.2.4 Employment (Paid and Unpaid) | 2-9 |
| | 2.2.2.5 Costs and Returns for Flow Through and Recirculating Commercial Facilities | 2-9 |
| | 2.2.2.6 “Captive Facilities” | 2-11 |
| 2.2.3 | Company Information | 2-11 |
| | 2.2.3.1 Number of Companies | 2-11 |
| | 2.2.3.2 Company Organization | 2-11 |
| | 2.2.3.3 Revenues | 2-12 |
| | 2.2.3.4 Number of Small Business | 2-12 |
| | 2.2.3.5 Assets | 2-12 |
| 2.3 | NONCOMMERCIAL FACILITIES | 2-13 |
| | 2.3.1 Facility Counts | 2-13 |
| | 2.3.2 Production | 2-13 |
| | 2.3.3 Employment | 2-14 |
| | 2.3.4 Funding Sources | 2-14 |
| 2.4 | REFERENCES | 2-15 |
| CHAPTER 3 ECONOMIC IMPACT METHODOLOGY | | 3-1 |
| 3.1 | COST ANNUALIZATION MODEL | 3-1 |
| | 3.1.1 Input Data Sources | 3-1 |
| | 3.1.2 Depreciation Method | 3-4 |
| | 3.1.3 Tax Rates | 3-5 |
| | 3.1.4 Tax Shield Not Included | 3-7 |
| | 3.1.5 Sample Cost Annualization Spreadsheet | 3-7 |
| 3.2 | COMMERCIAL FACILITIES | 3-10 |
| | 3.2.1 Closure Analysis | 3-10 |
| | 3.2.1.1 Data Sources for Forecasting Methods | 3-12 |
| | 3.2.1.2 Forecasting Methods | 3-14 |
| | 3.2.1.3 Index For Use in Projecting Future Earnings | 3-15 |
| | 3.2.1.4 Selected Projection Methods for Future Earnings | 3-16 |
| | 3.2.1.5 Pre-Regulatory Financial Conditions and Baseline Closures ... | 3-22 |
| | 3.2.1.6 Projecting Facility Closures under the Final Regulation | 3-25 |
| | 3.2.1.7 National (Direct and Indirect) and Community Impacts | 3-25 |
| | 3.2.2 Other Regulatory Impact Criteria | 3-26 |
| | 3.2.2.1 Sales or Revenue Test | 3-26 |
| | 3.2.2.2 Credit Test | 3-27 |
| | 3.2.2.3 Financial Health | 3-28 |
| | 3.2.2.4 Other Financial Data and Criteria | 3-28 |
| 3.3 | NONCOMMERCIAL FACILITIES | 3-31 |

| | | |
|------------------|---|------------|
| 3.3.1 | Closure of Noncommercial Facilities | 3-31 |
| 3.3.1.1 | National Fish Hatchery System | 3-32 |
| 3.3.1.2 | State Hatchery Closures and Potential Closures | 3-32 |
| 3.3.1.3 | Summary | 3-34 |
| 3.3.2 | State Hatcheries and User Fees | 3-34 |
| 3.3.3 | Economic Tests | 3-38 |
| 3.3.3.1 | Budget Test | 3-38 |
| 3.3.3.2 | User Fee Analysis | 3-39 |
| 3.3.4 | Alaska Nonprofits | 3-40 |
| 3.4 | EPA DECISION MATRIX FOR ECONOMIC ACHIEVABILITY | 3-40 |
| 3.4.1 | Commercial Facility Impacts | 3-40 |
| 3.4.2 | Noncommercial Facility Impacts | 3-41 |
| 3.5 | BARRIER-TO-ENTRY FOR NEW OPERATIONS | 3-41 |
| 3.6 | MARKET IMPACTS | 3-42 |
| 3.6.1. | U.S. Aquaculture Compared to Other World Aquaculture Markets | 3-43 |
| 3.6.2 | Intra-national Competition from Wild and Noncommercial or Public Sources | 3-45 |
| 3.6.3 | Industry Concentration and Producer-Processor Relationships | 3-47 |
| 3.6.4 | Summary | 3-51 |
| 3.7 | REFERENCES | 3-51 |
| CHAPTER 4 | REGULATORY OPTIONS: DESCRIPTIONS AND COSTS | 4-1 |
| 4.1 | OPTION DESCRIPTION | 4-1 |
| 4.1.1 | Final Option | 4-1 |
| 4.1.2 | Options Discussed in 2003 Notice of Data Availability | 4-1 |
| 4.1.3 | Proposal Options | 4-2 |
| 4.2 | TREATMENT IN PLACE AND BASELINE CONDITIONS AMONG COMMERCIAL OPERATIONS | 4-3 |
| 4.3 | SUBCATEGORY AND INDUSTRY COSTS | 4-3 |
| 4.4 | COST-REASONABLENESS | 4-5 |
| 4.5 | REFERENCES | 4-5 |
| CHAPTER 5 | ECONOMIC IMPACT RESULTS | 5-1 |
| 5.1 | BEST AVAILABLE TECHNOLOGY FOR EXISTING SOURCES (BPT, BAT, AND BCT) | 5-1 |
| 5.1.1 | Commercial Facilities | 5-1 |

| | | |
|------------------|--|------------|
| | 5.1.1.1 Closures Analyses | 5-3 |
| | 5.1.1.2 Moderate Impacts | 5-3 |
| | 5.1.1.3 Sensitivity Analyses | 5-4 |
| 5.1.2 | Noncommercial Facilities | 5-5 |
| | 5.1.2.1 Budget Test | 5-5 |
| | 5.1.2.2 User Fee Test | 5-6 |
| | 5.1.2.3 Alaska Nonprofit Facilities | 5-6 |
| 5.1.3 | Other Technology Options Considered by EPA | 5-8 |
| | 5.1.3.1 Commercial Facilities | 5-8 |
| | 5.1.3.2 Noncommercial Facilities | 5-10 |
| 5.1.4 | Operations Producing Less than 100,000 lbs/yr | 5-10 |
| | 5.1.4.1 Description | 5-10 |
| | 5.1.4.2 Economic Impact Analysis | 5-12 |
| 5.2 | NEW SOURCE PERFORMANCE STANDARDS (NSPS) | 5-13 |
| 5.3 | MARKET AND FOREIGN TRADE IMPACTS | 5-13 |
| | 5.3.1 Market Impacts | 5-13 |
| | 5.3.2 Foreign Trade Impacts | 5-14 |
| 5.4 | REFERENCES | 5-14 |
| CHAPTER 6 | SMALL ENTITY FLEXIBILITY ANALYSIS | 6-1 |
| 6.1 | THE REGULATORY FLEXIBILITY ACT AS AMENDED BY THE SMALL BUSINESS REGULATORY ENFORCEMENT FAIRNESS ACT | 6-1 |
| 6.2 | INITIAL ASSESSMENT | 6-2 |
| | 6.2.1 Definitions of a Small Aquaculture Entity | 6-2 |
| | 6.2.2 Number of Small Businesses Affected by the Final Regulation | 6-3 |
| | 6.2.3 Results of the Initial Assessment for the 2002 Proposal | 6-3 |
| 6.3 | EPA COMPLIANCE WITH RFA REQUIREMENTS | 6-4 |
| | 6.3.1 Outreach and Small Business Advocacy Review | 6-4 |
| 6.4 | EPA'S SMALL BUSINESS FLEXIBILITY ANALYSIS | 6-4 |
| | 6.4.1 Need for and Objectives of the Final Regulation | 6-5 |
| | 6.4.2 Significant Comments in Response to the IRFA | 6-5 |
| | 6.4.3 Description and Estimate of Number of Small Entities Affected | 6-6 |
| | 6.4.4 Description of the Reporting, Recordkeeping, and Other Requirements | 6-6 |
| | 6.4.5 Steps Taken to Minimize Significant Economic Impacts on Small Entities | 6-7 |
| | 6.4.6 Identification of Relevant Federal Rules that May Duplicate, Overlap, or Conflict with the Final Rule | 6-7 |
| 6.5 | EPA'S ANALYSIS OF SMALL ENTITY IMPACTS | 6-7 |

| | | |
|---|--|------|
| 6.6 | REFERENCES | 6-8 |
| CHAPTER 7 ENVIRONMENTAL IMPACTS FROM AQUACULTURE FACILITIES 7-1 | | |
| 7.1 | INTRODUCTION | 7-1 |
| 7.2 | CAAP INDUSTRY DISCHARGES | 7-1 |
| 7.2.1 | Description of Industry | 7-1 |
| 7.2.2 | Discharges of Solids, Nutrients, and BOD | 7-2 |
| 7.2.2.1 | Introduction | 7-2 |
| 7.2.2.2 | Flow-through Systems | 7-2 |
| 7.2.2.3 | Recirculating Systems | 7-3 |
| 7.2.2.4 | Net Pen Systems | 7-6 |
| 7.2.2.5 | Estimated Annual Loads for In-scope Flow-through and Recirculating Facilities | 7-6 |
| 7.2.3 | Metals and Feed Additives/Contaminants | 7-11 |
| 7.2.4 | Other Contributions and Releases | 7-12 |
| 7.2.5 | Drugs and Pesticides | 7-13 |
| 7.2.6 | Pathogens | 7-14 |
| 7.3 | IMPACTS OF CAAP INDUSTRY DISCHARGES | 7-15 |
| 7.3.1 | Impacts from Solids, Nutrients, BOD, Metals, and Feed Contaminants | 7-15 |
| 7.3.1.1 | General Aquatic Ecosystem Effects | 7-15 |
| 7.3.1.2 | Recent Literature | 7-16 |
| 7.3.2 | Impacts from Other Releases | 7-19 |
| 7.3.2.1 | General Aquatic Ecosystem Effects | 7-20 |
| 7.3.2.2 | Recent Literature | 7-20 |
| 7.3.3 | Impacts from Drugs and Pesticides | 7-24 |
| 7.3.3.1 | Background | 7-24 |
| 7.3.3.2 | Environmental Effects Literature | 7-26 |
| 7.3.4 | Impacts from Pathogens | 7-31 |
| 7.4 | REFERENCES | 7-32 |
| CHAPTER 8 ENVIRONMENTAL BENEFITS OF FINAL REGULATION 8-1 | | |
| 8.1 | INTRODUCTION | 8-1 |
| 8.2 | MONETIZED BENEFITS | 8-2 |
| 8.2.1 | Overview of Method | 8-2 |
| 8.2.2 | Detailed Questionnaire Data | 8-3 |
| 8.2.3 | Extrapolation Framework | 8-4 |
| 8.2.3.1 | Factor 1: Regulatory Changes in Pollutant Loadings | 8-4 |
| 8.2.3.2 | Factor 2: Pollutant Concentration in Discharge | 8-4 |
| 8.2.3.3 | Factor 3: Dilution of Discharge in Receiving Water | 8-5 |

| | | |
|---|--|------------|
| 8.2.4 | Water Quality Modeling | 8-7 |
| 8.2.4.1 | Selection and Development of Case Studies | 8-7 |
| 8.2.4.2 | Model Configuration | 8-8 |
| 8.2.4.3 | Model Results | 8-12 |
| 8.2.5 | Economic Valuation | 8-15 |
| 8.2.5.1 | Economic Valuation Approach | 8-15 |
| 8.2.5.2 | Uncertainties and Other Considerations Regarding Benefits Valuation | 8-17 |
| 8.2.6a | Estimated National Water Quality Benefits—Options A and B | 8-20 |
| 8.2.6b | Estimated National Water Quality Benefits—Final Option | 8-22 |
| 8.2.7 | Sources of Uncertainty | 8-23 |
| 8.3 | REFERENCES | 8-24 |
| CHAPTER 9 OTHER REGULATORY ANALYSIS REQUIREMENTS | | 9-1 |
| 9.1 | ADDITIONAL ADMINISTRATIVE AND REGULATORY REQUIREMENTS | 9-1 |
| 9.1.1 | Requirements of Executive Order 12866 | 9-1 |
| 9.1.2 | Requirements of the Unfunded Mandates Reform Act (UMRA) | 9-2 |
| 9.2 | NEED FOR THE REGULATION | 9-3 |
| 9.3 | TOTAL SOCIAL COSTS | 9-3 |
| 9.3.1 | Costs to In-Scope Commercial and Noncommercial Facilities | 9-3 |
| 9.3.2 | Costs to the Permitting Authority (States and Federal Government) | 9-3 |
| 9.3.3 | Other Social Costs | 9-4 |
| 9.4 | POTENTIAL IMPACTS ON NONCOMMERCIAL FACILITIES | 9-5 |
| 9.5 | COMPARISON OF COST AND BENEFITS ESTIMATES | 9-5 |
| 9.6 | SUMMARY | 9-6 |
| 9.7 | REFERENCES | 9-4 |
| APPENDIX A CLOSURE ANALYSIS FINANCIAL TOPICS | | A-1 |
| A.1 | UNPAID LABOR AND MANAGEMENT | A-1 |
| A.1.1 | How Many Facilities Within The Scope of the Regulation Report Unpaid Labor and/or Management? | A-2 |
| A.1.2 | Baseline Status of These Facilities | A-2 |

| | | |
|--|--|------------|
| A.1.3 | Estimated Costs for Sensitivity Analysis | A-2 |
| A.1.4 | Results of the Sensitivity Analysis | A-3 |
| A.2 | SUNK COSTS | A-4 |
| A.3 | CAPITAL REPLACEMENT | A-4 |
| A.3.1 | Expenditures During the Useful Life of the Asset | A-4 |
| A.3.2 | Expenditures at the End of an Asset's Useful Life | A-5 |
| A.3.3 | EPA's Consideration of Capital Replacement in the Financial and Economic Analysis | A-6 |
| A.4 | DEPRECIATION | A-7 |
| A.5 | CASH FLOW | A-8 |
| A.6 | NET INCOME | A-10 |
| A.7 | REFERENCES | A-11 |
| APPENDIX B GIS TABLES FOR CHAPTER 7 | | B-1 |

TABLES

| <u>Table</u> | <u>Page</u> |
|---|-------------|
| ES-1 Estimated Number of Affected Facilities with Production > 100,000 lbs/yr | ES-4 |
| ES-2 National Costs: Total by Subcategory and Option | ES-8 |
| ES-3 Economic Effects: Existing Commercial & Noncommercial Operations | ES-10 |
| ES-4 Estimated Pre-Tax Annualized Compliance Costs and Monetized Benefits | ES-13 |
| 2-1 Estimated Number of In-Scope Facilities by Organization | 2-3 |
| 2-2 In-Scope Facilities by Geographic Distribution | 2-4 |
| 2-3 Estimated 2001 Revenues for Commercial In-Scope Facilities by Production System . . . | 2-6 |
| 2-4 Estimated Revenues for Commercial In-Scope Facilities by Production System 1999-2001 | 2-6 |
| 2-5 Conversion Factors for Reporting Production in Pounds (Abridged) | 2-7 |
| 2-6 Estimated 2001 Production Data for In-Scope Commercial Facilities by Production System | 2-8 |
| 2-7 Estimated Aggregate Production Data for In-Scope Commercial Facilities by Production System | 2-8 |
| 2-8 Total and Average Employment for In-Scope Commercial Facilities by Production System | 2-10 |
| 2-9 National Estimates of Costs and Returns at Commerical Facilities, 2001 | 2-10 |
| 2-10 Total and Average 2001 Assets Reported by In-Scope Commercial Facilities by Production System | 2-13 |
| 2-11 Estimated Production and Employment for In-Scope Noncommercial Facilities by Type | 2-14 |
| 3-1 State Income Tax Rates | 3-5 |
| 3-2 Concentrated Aquatic Animal Production Cost Annualization Model | 3-8 |
| 3-3 USDA Consumer Food Price Index-Food at Home Fish and Seafood | 3-12 |
| 3-4 Forecasting Indices | 3-22 |

| | | |
|------|---|------|
| 3-5 | Number and Types of Facilities in EPA’s Economic Analysis for the Final Regulation | 3-24 |
| 3-6 | History of Pennsylvania Fishing Licence Fees | 3-36 |
| 3-7 | 2003 Resident Fishing Licence Fees | 3-36 |
| 3-8 | Major Aquaculture Producer Countries in 2000 | 3-44 |
| 3-9 | 2001 Imports and Exports of Selected Seafood Products (\$1000) | 3-45 |
| 3-10 | Sources and Uses of Aquaculture Species in the United States, 1998 | 3-46 |
| 3-11 | Characteristics of Aquaculture Species Markets | 3-48 |
| 3-12 | Industry Concentration | 3-50 |
| 4-1 | Technologies or Practices by Option | 4-2 |
| 4-2 | Estimated Number of Facilities with Production > 100,000 lbs/yr | 4-3 |
| 4-3 | Pre-Tax & Post-Tax Annualized National Costs, Total by Subcategory and Option | 4-4 |
| 5-1 | Economic Effects: Existing Commercial & Noncommercial Operations | 5-2 |
| 5-2 | User Fee Analysis for Government Facilities | 5-7 |
| 5-3 | Impacts for All Commercial Facilities, All Production Systems | 5-9 |
| 5-4 | User Fee Analysis for Government Facilities | 5-11 |
| 5-5 | Numbers and Types of Facilities with Annual Production between 20,000 and 100,000 Pounds | 5-12 |
| 6-1 | Small Business Size Standards | 6-3 |
| 7-1 | Water Quality Data for Three Trout Farms in Virginia | 7-4 |
| 7-2 | Flow-through Sampling Data Table | 7-5 |
| 7-3 | Water Quality Characteristics of Effluent at Various Points in the Waste Treatment System of Recirculating Aquaculture Systems at the North Carolina State University Fish Barn | 7-5 |
| 7-4 | Recirculating System Sampling Data | 7-6 |
| 8-1 | Summary of Environmental Benefits of the Final Rule | 8-2 |

| | | |
|------|---|------|
| 8-2 | Definition of Extrapolation Categories* and National Estimates for the Number of Facilities In-scope for the Regulation—Option B Only. | 8-6 |
| 8-3 | Summary of QUAL2E Run Results | 8-15 |
| 8-4 | Index Values for Nutrient Criteria | 8-20 |
| 8-5a | National Water Quality Benefit Estimate for Option B | 8-21 |
| 8-5b | National Water Quality Benefit Estimate for the Final Option | 8-22 |
| 9-1 | Estimated Pre-Tax Annualized Compliance Costs and Monetized Benefits | 9-5 |
| A-1 | Cash Flow Versus Accounting Income | A-8 |

FIGURES

| <u>Figure</u> | <u>Page</u> |
|---------------|---|
| 2-1 | Estimated Number of In-Scope Facilities by Organization 2-3 |
| 3-1 | Commercial Facilities: Economic Analysis Flowchart 3-2 |
| 3-2 | Noncommercial Facilities: Economic Analysis Flowchart 3-3 |
| 3-3 | Annual USDA Consumer Food Price Index-Food at Home Fish and Seafood 3-17 |
| 3-4 | Unprocessed and Packaged Fish-Monthly PPI 3-17 |
| 3-5 | Shrimp-Monthly PPI 3-18 |
| 3-6 | Food Size Trout-Sales of Fish 12" or Longer Annual U.S. Average Price per Pound . . . 3-18 |
| 3-7 | Fulton Fish Market-Fresh Boned Idaho Trout Monthly Price per Pound 3-19 |
| 3-8 | Unprocessed and Package Fish-Monthly PPI 3-19 |
| 3-9 | Shrimp-Monthly PPI 3-20 |
| 3-10 | Food Size Trout-Sales of Fish 12" or Longer: U.S. Annual Average Price per Pound . . . 3-20 |
| 3-11 | Fulton Fish Market-Fresh Boned Idaho Trout: Monthly Price per Pound 3-21 |
| 3-12 | Forecasting Price Indices 3-21 |
| 7-1 | Estimated Baseline Loads of BOD for In-scope Flow-through and Recirculating Facilities 7-7 |
| 7-2 | Estimated Baseline Loads of TSS for In-scope Flow-through and Recirculating Facilities 7-8 |
| 7-3 | Estimated Baseline Loads of Total Nitrogen for In-scope Flow-through and Recirculating Facilities 7-9 |
| 7-4 | Estimated Baseline Loads of Total Phosphorus for In-scope Flow-through and Recirculating Facilities 7-10 |
| 8-1 | Sample QUAL2E output for baseline discharges 8-13 |
| 8-2 | Sample QUAL2E output for post-regulatory discharges 8-13 |
| 8-3 | Comparison of baseline and post-regulatory WQI6 values from sample QUAL2E output 8-14 |